CLEAR LAKE ENHANCEMENT PROJECT
Supporting Design Report
for Improvement of the Clear Lake Sediment Trap

Prepared for
City of La Porte
Park and Recreation Department
La Porte, Indiana

December, 1995

HARZA *Consulting Engineers and Scientists*

HUC 07120001030050

Clear Lake Enhancement Project
Sediment Trap Improvement

TABLE OF CONTENTS

Clear Lake Enhancement Project
Sediment Trap Improvement

INTRODUCTION

This Supporting Design Report summarizes the procedures, criteria, and results of analyses used for the design of the Clear Lake Sediment Trap Improvement project. The sediment trap must be improved to more efficiently trap sediment entering Clear Lake. Sediment in stormwater tends to have high levels of pollutants adhered to the sediment particles.

Improvement of the Clear Lake Sediment Trap is being performed by the City of LaPorte, Park and Recreation Department with partial funding from the Indiana Department of Natural Resources "T by 2000" Lake and River Enhancement Program. Project works includes the renovation of an existing underwater dam, removal of accumulated sediment, disposal of removed sediment, and planting of wetland vegetation.

This report includes a narrative section describing the various design features, followed by attachments which contain design computations and supporting information. Reduced sized design drawings are included as Exhibits. The contract documents (bound separately) provide the construction requirements for the project.

LOCATION

Clear Lake is located within the limits of the City of La Porte in La Porte County, Indiana. The project location is shown on Exhibit 1. The sediment trap is located at the intersection of Clear Lake Boulevard and Hoelocker Drive, in the southern extremity of the lake.

Project features are shown on Exhibit 2. The sediment trap consists of a stormwater inflow pipe, a sediment accumulation pond, and an underwater dam. A land and bathymetric survey of the sediment trap was completed August 30, 1993. The survey data is attached in Appendix A.

A concrete headwall serves as a local bench mark located along Hoelocker Drive about 600 feet northwest of the sediment trap as shown on Exhibit A.2 in Appendix A. The northeast corner of the headwall is at elevation 801.88 feet mean sea level datum.

The stormwater inflow culvert is located at the south corner of Clear Lake. The terminus of the stormwater inflow culvert is located 658.02 feet south and 392.14 feet east of the local bench mark. The Clear Lake water elevation varies. Normal water level was established by LaPorte Circuit Court in 1949 as elevation 798.2 feet mean sea level datum.

The existing dam crest varies from elevation 798 to elevation 800.

LEGAL DESCRIPTION OF PROJECT FEATURES

Clear Lake sediment trap is located in the northwest quarter of the southeast quarter of the northeast quarter of Section 35, Township 37 North, Range 3 West, of the 86 Principal Meridian.

GENERAL DESCRIPTION

Clear Lake is a public recreation and scenic resource. Principal activities are non-power boating, fishing, and activities in the adjacent park on the north shore. The date of construction of the existing Clear Lake sediment trap is not known. Project features are shown on Exhibit 2. The sediment trap consists of a 48-inch diameter stormwater inflow pipe, a sediment accumulation pond, and a 10-foot-high 190-foot-long underwater barrier.

OBJECTIVES OF PROJECT DESIGN

Background

Harza Engineering Company was retained in 1989 by the City of La Porte, Park and Recreation Department to evaluate the feasibility of alternative methods for enhancing Clear Lake. Harza concluded that water quality in Clear Lake could be improved over the long-term by annually removing aquatic plants from the lake and by improving the efficiency of sediment trapping at the primary stormwater inflow location.

Upon Harza's recommendation the City of La Porte Park and Recreation Department has implemented an aquatic plant harvesting program. Aquatic plants utilize phosphorus and nitrogen in the normal plant growth cycle. The phosphorus and nitrogen is returned to the lake system, however, when the plants die and decay. By cutting and removing the aquatic plants, phosphorus and nitrogen is removed from the lake.

Design Objectives

Clear Lake is an asset to the City of La Porte, providing an excellent fishing, recreation and scenic resource within the city limits. The design objectives are to further enhance Clear Lake and the Clear Lake water quality by improving the efficiency of the sediment trap in the south corner of the lake to reduce sediment and sediment-adhered nutrient loading. The overall lifespan of the lake will be prolonged by slowing the accumulation of sediment in the lake bottom. The tendency of the lake to produce undesirable weeds will be reduced by controlling the influx of nutrients which adhere to fine sediments.

Construction Requirements

The City of La Porte Park and Recreation Department again retained Harza Engineering Company in 1993 to design the improvement of the Clear Lake sediment trap. Improvement of the Clear Lake sediment trap involves five construction tasks.

The first task includes mobilization and demobilization of construction equipment, materials and manpower to do the work. Demobilization will not be complete until clean-up of the site is considered complete by the inspector.

The second task is the renovation of the existing rubble fill barrier dike. The existing barrier dike will be renovated to provide dispersion of the primary flow plume. The existing central breach area will be filled to elevation 798 feet using rubble excavated from the notches and new notches will be excavated in the existing barrier dike as shown on Exhibit 2.

The third task involves removal and off-site disposal of accumulated sediment. The depth and character of the accumulated sediment was evaluated by the soil exploration and testing program and the bathymetric survey program. Accumulated sediment will be removed to a depth of elevation 793 feet as shown on Exhibit 2, and properly disposal of at an off-site upland location.

The fifth task involves transplanting of wetland vegetation. The wetland vegetation will be obtained from the northeast end of Clear Lake where it can be excavated in mass using a back-hoe or front-end loader, or from commercial vendors. It will be planted onto the barrier dike.

The sixth task is restoration of the shoreline to preconstruction condition. Parts of the shoreline disturbed by construction equipment will be regraded and reseeded or otherwise restored to a neat appearance.

SURVEYING

Mapping and surveying was conducted at Clear Lake during the months of April, May and August 1993. The mapping and surveying work included a bathymetric survey of top of muck and firm lake bottom elevations, a land survey of existing features, and horizontal and vertical control for layout purposes. The survey information is attached in Appendix A.

The bathymetric soundings were conducted by dropping a tape attached to a one-foot-square wooden plate. The plate would come to rest on the lake bottom for a "top of muck" elevation. At some sounding locations, a second elevation was determined using a rigid probe. The probe was pushed into the lake bottom to refusal yielding "firm bottom" elevations. The sounding locations were established using a total station set-up on the lake shore.

SOIL EXPLORATION AND TESTING

Subsurface soil exploration and laboratory testing of soil samples were conducted by Harza. The results of the soil exploration and testing were used to determine criteria for the restoration of the Clear Lake sediment trap. The soil exploration and testing report is attached in Appendix B.

Field work, consisting of four hand auger borings, was conducted on March 18, 1993. The borehole locations are shown on Exhibit 2. Borehole BH-1 was located along the east shoreline of the existing sediment trap just inside the existing sediment trap area. Borehole BH-2 was located near the center of the sediment trap, twenty five feet from the sediment trap dam. Borehole BH-3A and BH-3 were located at the south end of the existing sediment trap near the stormwater inflow culvert.

Sampling was conducted and samples were visually classified in the field. Soil samples were retained for testing in Harza's soil laboratory. Laboratory testing included Atterberg limits, gradation analysis, visual classification, and Standard Proctor for selected samples.

SEDIMENT TESTING

Following discussions about Harza's proposed sediment sampling and testing plan with the Indiana Department of Environmental Management, sediment sampling was conducted on May 1, 1993. Standard coring techniques were used to collect cores inside and immediately outside the existing sediment trap. Core samples were composited to create a single sample for testing. The composite sample was submitted to National Environmental Testing, Inc. of Bartlett, Illinois for testing to evaluate possible sediment contamination and disposal options.

The sediment was tested to determine total organic carbon (TOC) and the Toxicity Characteristic Leaching Procedure (TCLP) was conducted to assess the potential hazard of the sediment to human health and the environment. The accumulated sediment in the existing sediment trap is not hazardous. No organic or inorganic contaminants exceeded the TCLP benchmarks defining a material as hazardous. No special handling, manifesting, or disposal methods are therefore required for sediment excavated during this project. The sediment analytical report is attached in Appendix C.

HYDROLOGY AND HYDRAULICS

Hydrologic and hydraulic computations were conducted to determine the stormwater inflow rate and backwater effects (Appendix D). The Clear Lake watershed area is relatively small, about 88 acres. The watershed is residential and commercial areas, including downtown La Porte. A dense network of storm sewers conveys the runoff flow north to the lake. Most of the basin is separated from the lake by a railroad embankment (shown on Exhibit 1), effectively eliminating the possibility of overland flow from the areas south of the railroad embankment. Thus the majority of flow must enter the lake through the 48-inch storm sewer passing under the railroad tracks; any improvements to the sewer trunk may affect the efficiency of the sediment trap. The sediment trap is intended to function for sediment suspended in storm water runoff which enters Clear Lake at the location of the sediment trap. Any surface inflow which enters Clear Lake outside of the sediment trap will not be treated by the sediment trap.

Assumptions

Surface inflow which enters Clear Lake through the sediment trap must first flow over Hoelocker Drive and Clear Lake Boulevard. The roadway was assumed to have a uniform elevation of 803.65 feet and a length of 800 feet along the sediment trap. The ground opposite the sediment trap along the roadway was assumed to have a uniform elevation of 801.15 feet for width of 100 feet. Surface water inflow is attenuated and insignificant in magnitude.

In the back-water computations, it was assumed that the sediment trap would be responsible only for the differential head over the underwater dam. High Clear Lake water elevations may affect storm water inflow, however, the sediment trap does not influence the water elevation of Clear Lake.

Procedures

The runoff rate was determined using the Rational equation. Flood discharge volume was estimated to evaluate qualitative effects of peak runoff attenuation. The maximum pipe inflow volume was calculated using Manning's equation. The head required for flow over the sediment trap dam was calculated using the weir-flow equation.

Hydraulic Design Criteria

The structures must not cause significant backwater effect on upstream areas.

The structures must be designed for the 100-year, 24-hour storm event.

Resulting Design

The storm sewer pipe can only convey about 130 cfs. The 100-year peak flood discharge is near 400 cfs, greatly exceeding the capacity of the pipe. The surface inflow peak is attenuated upstream to the point that the actual maximum inflow is approximately equal to the computed maximum pipe inflow rate of 130 cfs (see Appendix D computations). Flows above the 130 cfs will pond up south of the railroad embankment.

A design storm water peak inflow of 130 cfs was selected.

The existing underwater dam will be rehabilitated of rock fill. The total crest length will be about 190 feet. The side slopes will be 3H to 1V on the upstream face, and 1.5H to 1V on the downstream face of the dam. The crest width will vary, from 3 feet to a maximum of 15 feet in the center. The maximum crest elevation will be 800.

Wetland vegetation will be planted on the crest and embankments for aesthetic reasons and to aid in the trapping and treating of fine grained sediment.

The improved sediment trap will cause negligible backwater effects. The elevation of the sediment trap will generally be within 0.01 feet of the elevation of Clear Lake as shown in the attached computations in Appendix D.

STABILITY ANALYSES

Assumptions

The existing underwater barrier is constructed of rubble fill. Side slopes vary. The crest elevation also varies but the average elevation is about 799.0. The crest is relatively narrow. The toe of the underwater barrier is at a minimum elevation of about 790 feet. The underwater barrier is about 10 feet high at the maximum section.

The underwater barrier is generally submerged over part of the crest length, therefore the water levels on both sides of the barrier are normally equal. In the case of flood inflow to the sediment trap, the storm water will flow over the barrier crest as over a submerged broad-crested weir. The design inflow is estimated at 130 cfs. The crest length is so long that the head differential over the crest from upstream to downstream will be minimal.

The underwater barrier has been in place for several decades and is inherently stable. The structure was checked for stability assuming the worst case scenario, sliding on an assumed weak foundation.

Models and Procedures

The wedge method of analysis is appropriate for embankments on foundations containing weak foundation strata. Appendix E contains the details of the stability analysis method and results.

The barrier dike is not a dam because the water level is approximately the same on both sides. Barrier failure would not cause damage to lives or property. Surficial sloughing would be a maintenance nuisance but will not affect overall stability.

In order to construct the underwater barrier embankment and to perform future maintenance, the structure must be stable, however, factor of safety values do not need to meet dam safety criteria.

Results

Stability analysis indicates that the existing rubble dike is stable with high factors of safety. The minimum factor of safety is 1.31 (Table 1). The factor of safety values listed in Table 1 are computed using a computer program to search for critical values. Dike stability is adequate as designed and the factor of safety values are acceptable.

Table 1

STABILITY ANALYSIS

Design Criteria:

$h_1 = 3$
$h_2 = 2$
$\gamma = 105$
$\gamma\beta = 47.5$
$\phi = 45$

Passive Wedge Resisting Force = 236 lbs

	Active Driving Force (lbs)							
α	Wgt 1	Wgt 2	Tot Wgt	Hor Force 1	Hor Force 2	Tot Hor Force	Resisting Force	Factor of Safety
1	3.7	14.7	18.4	3.6	14.2	17.8	236.0	13.29
10	37.7	148.1	185.8	26.4	103.7	130.1	236.0	1.81
20	77.8	305.7	383.5	36.3	142.6	178.8	236.0	1.32
24	95.2	374.0	469.2	36.5	143.6	180.1	236.0	1.31
30	123.4	485.0	608.4	33.1	129.9	163.0	236.0	1.45
44	206.4	811.2	1017.6	3.6	14.2	17.8	236.0	13.29

SEDIMENT TRAP SIZE DETERMINATION

The geotechnical analysis indicates that the accumulated sediment inside the sediment trap is 60 to 75 percent sand and gravel and 25 to 40 percent silt and clay. There is a layer of fine sediment in the bottom of Clear Lake. This is because the sediment trap is allowing some of the fine sand to pass through the sediment trap. The trap is also ineffective at trapping silt or smaller particles because of the small size and resultant low detention time in the trap.

The surface area of the existing sediment trap will not change from the existing condition. At a future date, or simultaneously with sediment trap reconstruction, a coagulant dosing system will be installed in the storm sewer upstream of Clear Lake. The coagulant would increase incoming particle sizes and sedimentation velocities, and thereby greatly increase the trapping efficiency of the sediment trap.

SEDIMENT DISPOSAL

Two primary alternatives for sediment disposal were considered. The sediment can be removed hydraulically or mechanically. In order to remove the sediment using a hydraulic dredging operation, a suitable site where the dredged material may settle must be located relatively near the sediment trap. No suitable site exists. Therefore, mechanical sediment removal is recommended.

The accumulated sediment includes gravel, sand, and fine-grained materials. The finer materials may be difficult to remove mechanically because of its high moisture content. However, the sediment contains a large percentage of sand, which will be simply removed using conventional equipment. No special handling, manifesting, or disposal methods are therefore required for sediment excavated during this project. The sediment analytical report is attached in Appendix C.

WETLAND VEGETATION PLANTING

Wetland vegetation can enhance the sediment trap process by increasing trapping efficiency and by absorbing and assimilating pollutants. Wetland vegetation will be transplanted onto the barrier dike from adjacent areas in Clear Lake or another of the Owner's lakes nearby, as directed in the field by the Engineer. Wetland vegetation will be transplanted with hydrosoil intact, using a front-end loader or comparable equipment. In this manner, root stock and wetland seed bank will be transplanted onto the underwater dam at the lowest cost with the greatest probability of successful revegetation.

INSPECTION PLAN

Inspection during construction will be required in order to verify quality of construction and construction quantities. The inspection plan is attached in Appendix F.

LONG-TERM OPERATION

The Operation & Maintenance/Monitoring plan is attached in Appendix G.

PERMIT REVIEW

State and federal regulatory requirements for construction are tabulated below. The owner is responsible for obtaining Federal and State permits and approvals. The contractor will normally be responsible for procuring any local permits and approvals, including City of LaPorte Ordinance No. 5-91 (Title 21 - Wetlands Protection).

Table 2

LIST OF PERMITS

Agency	Action Type	Permit/Review	Normal Review Period
USACE	Permit	Section 404 "Dredge and Fill" Permit	60 days
USEPA	Review	Wetlands "No Net Loss" Review	60 days
USFWS	Review	Fish and Wildlife Coordination Act Review	By agreement with USACE
USFWS	Review	Endangered Species Act Review	1 to 6 months
IDEM	Permit	Section 401 Water Quality Certification	30 to 60 days
IDNR	Permit	Construction in a Public Lake Permit	60 days
IDNR	Review	Section 106 (Cultural Resources) Review	30 days

CONSTRUCTION COST ESTIMATE

Harza's estimate of the probable construction cost is $116,000. The cost estimate details are attached in Appendix H

EXHIBIT 1

CITY OF LAPORTE

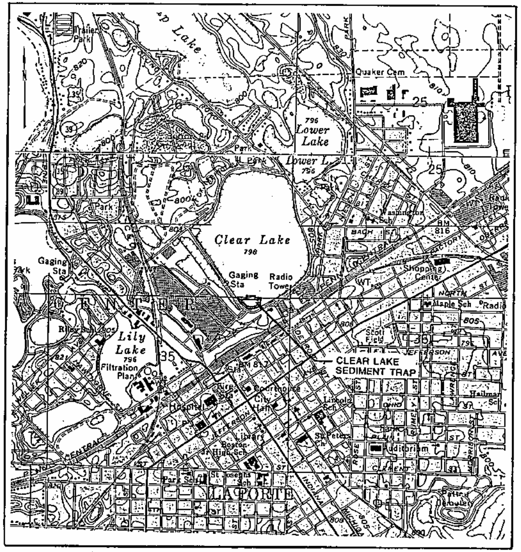
PARK AND RECREATION DEPARTMENT

LAPORTE, INDIANA

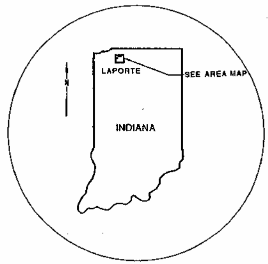
PLANS FOR

IMPROVEMENT OF CLEAR LAKE SEDIMENT TRAP

DEC. 1995



AREA MAP
N.T.S.



KEY PLAN

HARZA ENGINEERING COMPANY
CONSULTING ENGINEERS
CHICAGO, ILLINOIS

5129G-01

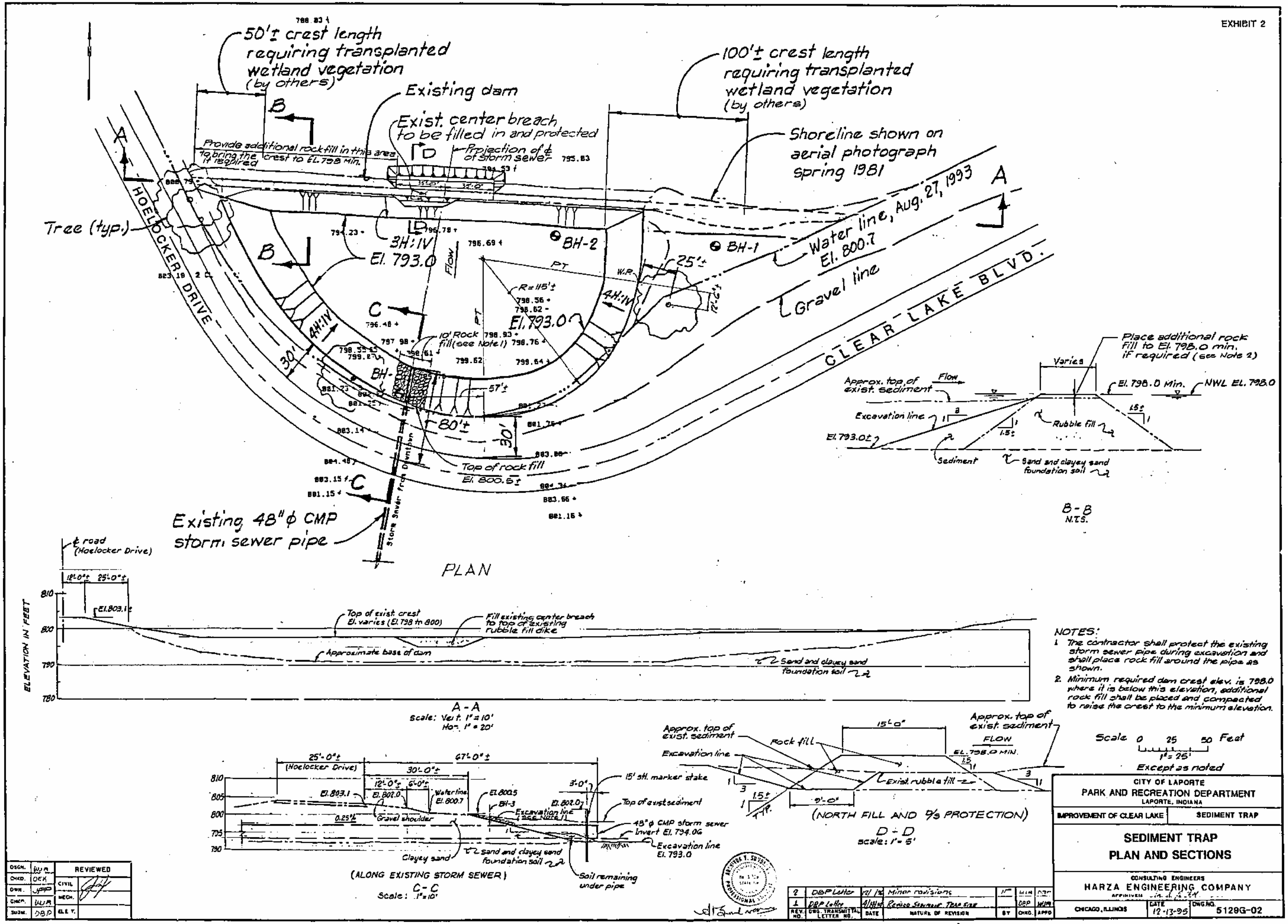
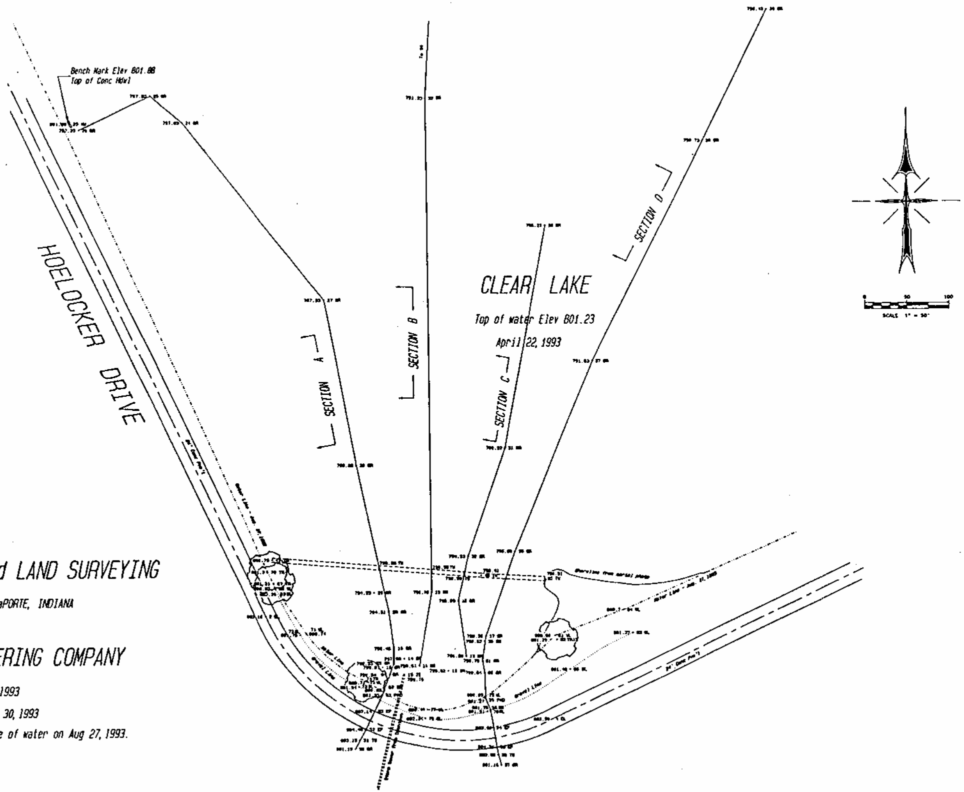


EXHIBIT 2
50'± crest length requiring transplanted wetland vegetation (by others)
Existing dam
Exist. center breach to be filled in and protected
Projection of ℄ of storm sewer
Provide additional rock fill in this area to bring the crest to El. 798 Min. if required
100'± crest length requiring transplanted wetland vegetation (by others)
Shoreline shown on aerial photograph spring 1981
Water line, Aug. 27, 1993 El. 800.7
Gravel line
CLEAR LAKE BLVD.
HOELOCKER DRIVE
Tree (typ.)
3H:1V
El. 793.0
Flow
BH-2
BH-1
R=115'±
PT
4H:1V
25'±
10' Rock fill (see Note 1)
57'±
80'±
30'
Top of rock fill El. 800.5±
Existing 48"ϕ CMP storm sewer pipe
Storm Sewer from Downtown
PLAN
Place additional rock fill to El. 798.0 min. if required (see Note 2)
Varies
Approx. top of exist. sediment
Flow
El. 798.0 Min.
NWL El. 798.0
Excavation line
Rubble fill
El. 793.0±
Sediment
Sand and clayey sand foundation soil
B-B
N.T.S.
℄ road (Hoelocker Drive)
ELEVATION IN FEET
El. 803.1±
Top of exist. crest El. varies (El. 798 to 800)
Fill existing center breach to top of existing rubble fill dike
Approximate base of dam
Sand and clayey sand foundation soil
A-A
Scale: Vert. 1" = 10' Hor. 1" = 20'
NOTES:
1. The contractor shall protect the existing storm sewer pipe during excavation and shall place rock fill around the pipe as shown.
2. Minimum required dam crest elev. is 798.0 where it is below this elevation, additional rock fill shall be placed and compacted to raise the crest to the minimum elevation.
25'-0"± (Hoelocker Drive)
67'-0"±
30'-0"±
12'-0"±
6'-0"±
El. 803.1
El. 802.0
Water line El. 800.7
El. 800.5
BH-3
El. 802.0
15' stl. marker stake
Top of exist sediment
Gravel shoulder
Excavation line (see Note 1)
48"ϕ CMP storm sewer Invert El. 794.06
Excavation line El. 793.0
Clayey sand
Sand and clayey sand foundation soil
Soil remaining under pipe
(ALONG EXISTING STORM SEWER)
C-C
Scale: 1"=10'
Approx. top of exist. sediment
Rock fill
Excavation line
15'-0"
EL. 798.0 MIN.
FLOW
Exist. rubble fill
9'-0"
(NORTH FILL AND P/S PROTECTION)
D-D
Scale: 1" = 5'
Scale 0 25 50 Feet
1" = 25'
Except as noted
CITY OF LAPORTE
PARK AND RECREATION DEPARTMENT
LAPORTE, INDIANA
IMPROVEMENT OF CLEAR LAKE
SEDIMENT TRAP
SEDIMENT TRAP PLAN AND SECTIONS
CONSULTING ENGINEERS
HARZA ENGINEERING COMPANY
CHICAGO, ILLINOIS
DATE 12-13-95
DWG. NO. 5129G-02
REVIEWED
Minor revisions
Revised Sediment Trap Size
NATURE OF REVISION

Appendix A

SURVEYING



BATHYMETRIC and LAND SURVEYING

CLEAR LAKE, LaPORTE, INDIANA

For

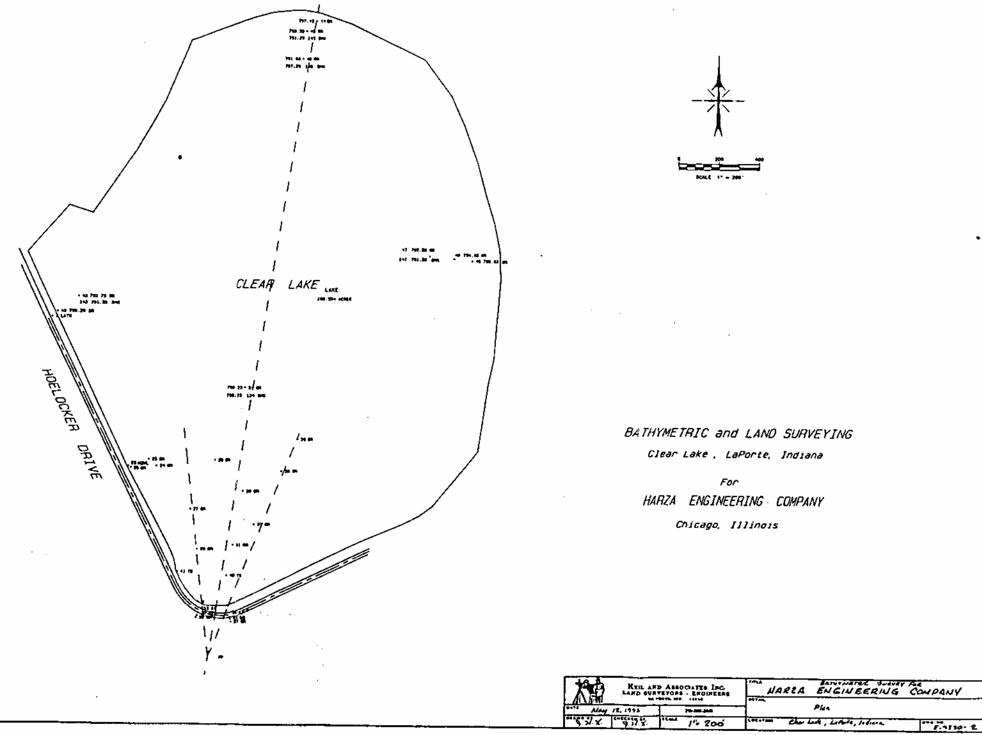
HARZA ENGINEERING COMPANY

MAY 12, 1993

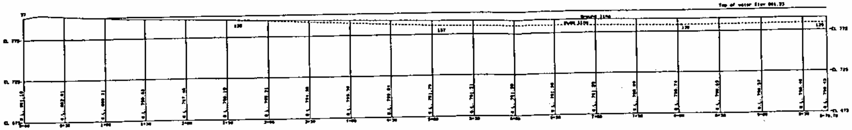
Revised Aug 30, 1993

Showed gravel line and edge of water on Aug 27, 1993.

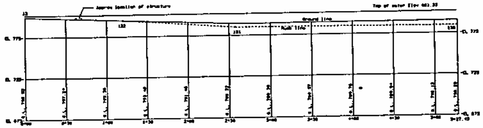
Heil and Associates, Inc. Land Surveyors - Engineers	TITLE: Bathymetric Survey for HARZA ENGINEERING COMPANY
DATE: May 12, 1993	DETAIL: Plan
DRAWN BY: JNK / CHECKED BY: JNK / SCALE: 1" = 50'	LOCATION: Clear Lake, LaPorte, Indiana / DWG NO. E-9330-1



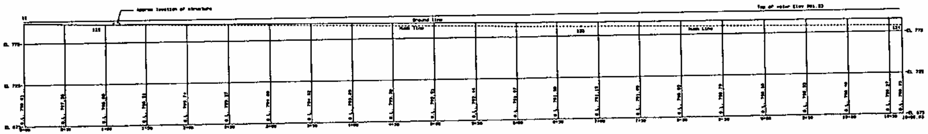
CLEAR LAKE
HOELOCKER DRIVE
SCALE 1" = 200'
BATHYMETRIC and LAND SURVEYING
Clear Lake , LaPorte, Indiana
For
HARZA ENGINEERING COMPANY
Chicago, Illinois
KEIL AND ASSOCIATES INC.
LAND SURVEYORS · ENGINEERS
May 12, 1995
1" = 200'
HARZA ENGINEERING COMPANY
Plan



PROFILE FOR SEC D
HOR/VERT SCALE=50/50



PROFILE FOR SEC C
HOR/VERT SCALE=50/50



PROFILE FOR SEC B
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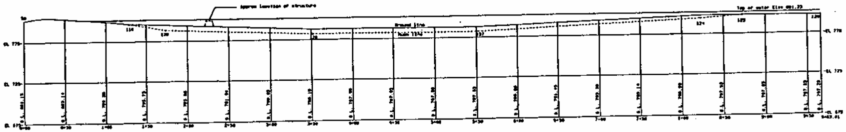


PROFILE FOR SEC A
HOR/VERT SCALE=50/50

CROSS PROFILE SECTIONS

HARZA ENGINEERING COMPANY
Chicago, Illinois

KEIL and ASSOCIATES, INC.
1719 State Street
LaPorte, Indiana 46350

KEIL AND ASSOCIATES INC. LAND SURVEYORS - ENGINEERS		TITLE: Bathymetric Survey For HARZA ENGINEERING COMPANY	
DATE: May 19, 1993		DETAIL: Cross Profile Sections	
DRAWN BY: JHK	CHECKED BY: JHK	SCALE: 1" = 50/50	LOCATION: Clear Lake, LaPorte, Indiana	DWG. NO.: E-7380-3

****

KEIL AND ASSOCIATES, INC ES-1802M
JOB NAME...HARZA JOB CODE...00009330
DATE:05-14-1993 TIME:07:09:14
POINTS--------COORDINATES---N/E/EL/DESCR.---------------210

****

#	NORTH	EAST	ELEVATION	DESCRIPTION
1	5000.000000	5000.000000	802.41	IP
2	5123.939980	4799.356710	803.18	CL
3	6435.151110	4171.415120	802.83	CL
4	5000.272140	5138.599350	803.59	CL
5	5025.898960	4933.946640	801.57	IP
6	5018.658720	5062.644900	801.66	IP
7	6447.223940	4191.219920	801.39	LATH
8	7997.750070	5486.871990	800.90	LATH
9	5040.869390	4916.375170	801.23	PND
10	5062.833890	4935.923200	799.07	GR
11	5064.202880	4978.396810	798.61	GR
12	5058.191310	5013.933210	799.62	GR
13	5075.848970	5035.201210	798.93	GR
14	5072.806700	4960.613030	797.98	GR
15	5053.720030	4960.414280	799.76	IE
16	5085.292930	4949.029020	796.48	GR
17	5099.620960	5058.987400	798.56	GR
18	5141.670600	5025.976570	796.69	GR
19	5151.900650	4994.256750	796.78	GR
20	5128.549580	4943.578110	794.91	GR
22	4772.504230	4962.683850	805.82	PP
23	5711.740180	4568.270680	801.88	HW
24	5712.841380	4701.365220	797.83	GR
25	5744.408620	4663.191220	797.83	GR
26	5704.140290	4578.835700	797.23	GR
27	5500.321390	4869.235610	787.83	GR
28	5303.538240	4906.385820	788.03	GR
29	5151.731940	4926.590920	794.23	GR
30	5588.883800	5133.415870	790.23	GR
31	5323.669360	5083.438780	789.23	GR
32	5194.582890	5038.077690	794.53	GR
33	5741.771460	4990.037900	791.23	GR
34	6098.550770	5140.023920	790.23	GR
35	5200.623590	5094.941460	795.83	GR
36	5093.254020	5057.601100	798.62	GR
37	5427.090750	5188.604480	791.63	GR
38	5689.494570	5322.697570	790.73	GR
39	5845.701050	5401.241840	790.43	GR
40	5171.940750	5053.562730	798.41	TB
41	5191.082650	4807.233180	800.79	TB
42	6547.014620	4319.252510	793.73	GR
43	6472.167690	4216.868320	798.39	GR
44	7917.733710	5477.143620	797.43	GR
45	7866.679980	5427.930910	793.33	GR
46	7732.010160	5411.348880	791.63	GR
47	6755.974370	6043.830680	792.53	GR
48	6743.203740	6165.016010	794.83	GR
49	6733.814770	6254.176080	798.62	GR
50	4965.946740	4903.494710	801.15	GR
51	4976.200940	4908.905620	803.15	TB
52	4988.976390	4915.984090	804.48	EP
53	5010.500330	4926.233660	803.14	EP
54	4990.463290	5067.242090	803.08	EP
55	4967.396300	5071.076050	804.34	EP
56	4957.866520	5072.907930	803.66	TB
57	4945.895670	5076.430010	801.16	GR
58	5011.656130	5063.752950	801.76	GR
59	5024.893850	5057.779730	801.27	PND
60	5056.110740	5056.982540	799.64	GR
61	5070.047360	5054.440450	798.76	GR

62	5029.658890	4935.409760	801.25	PND
63	5039.135770	4938.529690	800.83	GR
64	5054.367710	4944.505750	799.54	GR
65	5066.521050	4948.591840	798.55	GR
110	5062.833890	4935.923200	799.07	BMK
111	5064.202880	4978.396810	798.61	BMK
112	5058.191310	5013.933210	799.62	BMK
113	5075.848970	5035.201210	798.93	BMK
114	5072.806700	4960.613030	797.98	BMK
116	5085.292930	4949.029020	796.48	BMK
117	5099.620960	5058.987400	798.56	BMK
118	5141.670600	5025.976570	796.69	BMK
119	5151.900650	4994.256750	796.78	BMK
120	5128.549580	4943.578110	788.73	BMK
124	5712.841380	4701.365220	794.23	BMK
125	5744.408620	4663.191220	797.83	BMK
126	5704.140290	4578.835700	797.23	BMK
127	5500.321390	4869.235610	782.23	BMK
128	5303.538240	4906.385820	782.23	BMK
129	5151.731940	4926.590920	786.23	BMK
130	5588.883800	5133.415870	784.23	BMK
131	5323.669360	5083.438780	785.23	BMK
132	5194.582890	5038.077690	794.73	BMK
133	5741.771460	4990.037900	786.23	BMK
134	6098.550770	5140.023920	782.23	BMK
135	5200.623590	5094.941460	795.83	BMK
136	5093.254020	5057.601100	798.62	BMK
137	5427.090750	5188.604480	785.73	BMK
138	5689.494570	5322.697570	783.23	BMK
139	5845.701050	5401.241840	784.23	BMK
140	5171.940750	5053.562730	798.41	TB
141	5191.082650	4807.233180	800.79	TB
142	6547.014620	4319.252510	791.23	BMK
143	6472.167690	4216.868320	798.39	BMK
144	7917.733710	5477.143620	797.43	BMK
145	7866.679980	5427.930910	791.23	BMK
146	7732.010160	5411.348880	787.23	BMK
147	6755.974370	6043.830680	791.23	BMK
148	6743.203740	6165.016010	794.83	BMK
149	6733.814770	6254.176080	798.62	BMK

Appendix B

SOIL EXPLORATION & TESTING

Location: Chicago Office **Date** April 13, 1993

To: D.B Pott

From: C.M. Brown

Subject: Clear Lake Sediment Trap Improvement
Subsurface Exploration and Laboratory Analysis

In order to define the sediment trap site foundation characteristics, to characterize the accumulated sediment, and to establish design criteria; Harza conducted a subsurface exploration and laboratory testing program. The subsurface exploration program included four (4) boreholes drilled with a hand auger. The laboratory testing program included the following tests: Atterberg Limits; gradation analysis; and moisture content.

Hand auger drilling was conducted by Harza representatives Carl M. Brown and Chad O'Donnell on March 18, 1993. The laboratory testing was conducted in the Harza soils laboratory.

INTRODUCTION

Subsurface soil exploration and laboratory testing of soil samples were conducted in accordance with the Scope of Services in the Clear Lake Design Engineering Services Proposal, dated October 9, 1992. Clear Lake is located in LaPorte, Indiana (see Exhibit 1). The results of the soil exploration and testing were used to determine criteria for the restoration of the Clear Lake sediment trap. Restoration of the sediment trap will reduce sediment loading to the lake and thus will enhance the quality of Clear Lake.

The purpose of this report is to present, summarize, and interpret subsurface and laboratory information that has been gathered as a result of drilling and testing of selected soil samples.

FIELD WORK

Field work was conducted on March 18, 1993. Harza's Mr. Carl M. Brown, P.G., was responsible for the soil exploration and testing program. The boreholes were drilled by Carl Brown and Chad O'Donnell, Harza, using a hand auger. The subsurface exploration program is summarized below.

The borehole locations are shown on Exhibit 2. Borehole BH-1 was located along the west shoreline inside the sediment trap barrier dike on the right abutment. Borehole BH-2 was located near the center of the sediment trap, twenty five feet from the sediment trap dam. Borehole BH-3A was located at the south end of the sediment trap, west of the storm sewer pipe. BH-3 was located between BH-3A and the storm sewer pipe along the shoreline of the sediment trap.

Samples were obtained at approximately one-foot intervals and were visually classified in the field. Some samples were placed into bags or jars and retained by Harza for testing in Harza's soil laboratory.

LABORATORY TESTING

Laboratory testing included Atterberg Limits, gradation analysis, visual classification, and standard Proctor for selected samples.

SUMMARY OF FIELD AND LABORATORY RESULTS

BH-1. Soil boring BH-1 was drilled along the west shoreline of the lake inside the sediment barrier dike. The ground was covered with snow. Five inches of ice were chipped away. Beneath the six inches of snow and ice was a layer of black, clayey, sandy, organic soil six inches thick. Beginning at a depth of one foot was 18 inches of black organic, sandy clay soil. From 2.5 to 7 feet in depth, the soil was dark gray sandy clay. The sand content increased slightly with depth and a trace of gravel was found. Beginning at a depth of 7 feet, was a gray well rounded, poorly graded quartz sand. The boring was drilled to a depth of 8.25 feet.

BH-2. Soil boring BH-2 was drilled near the center of the sediment trap. There was a layer of snow and ice above the water. The muck began at a depth of about 4.5 feet. At a depth of six feet a sample of black organic muck was retrieved. The organic content of the muck was determined to be 13.8 percent. Beneath the muck was a layer of black clay and organic soil, from about 7.75 to 8.5 feet in depth beneath the surface of the ice. From 8.5 to 10.5 feet the soil was gray clayey sand. Beneath the gray clayey sand was a 6 inch layer of gray coarse sandy clay. From 11 feet to the end of boring at 12 feet was gray clayey sand.

BH-3A. Soil boring BH-3A was drilled along the south shore of the sediment trap. The storm sewer pipe location was not visible beneath the snow and ice. The auger reached refusal at a depth of two feet. The upper soil was organic soil with sand.

BH-3. Soil boring BH-3 was drilled between BH-3A and storm sewer pipe. The borehole was drilled to a depth of seven feet. The upper 18 inches was dark sandy organic topsoil with grass. Beneath the topsoil to a depth of five feet was a layer of red-brown clayey sand. From 3.5 to 4 feet deep some coarse sand and fine gravel sized flakes of shale were found. From 5 to 6 feet in depth was a layer of black clayey sandy organic soil. Beneath the black soil, the soil was gray, well rounded, poorly graded quartz sand with some flakes of shale.

CONCLUSION

The exploration program which was conducted at the Clear Lake sediment trap site is adequate for the design of the sediment trap restoration. The field exploration and laboratory testing programs have revealed information regarding the soil layers and the characteristics of the existing retained sediment. The foundation conditions at the sites are shown on the attached borehole logs.

EXHIBIT 1

INDIANA
Population: 5,571,900
(12-31-86 Estimate)
Land Area: 35,936 Sq. Mi.
Capital: Indianapolis

Cities and Towns

Albany............C-5
Albion............A-4
Alexandria.........D-4
Anderson..........D-4
Angola............A-5
Argos.............B-3
Attica............D-2
Auburn............A-5
Bedford...........F-3
Berne.............C-5
Bicknell..........G-2
Bloomfield.........F-2
Bloomington.......F-3
Bluffton...........C-5
Brazil.............E-2
Bremen............A-3
Brookville.........E-5
Brownsburg.......D-3
Brownstown........F-4
Cannelton.........H-3
Carmel............D-3
Charlestown.......G-5
Chesterton........A-2
Clinton............E-2
Columbia City......B-4
Columbus..........F-4
Connersville.......E-5
Columbus..........F-4
Connersville.......E-5
Corydon...........H-3
Covington.........D-2
Crawfordsville.....D-2
Crown Point.......A-2
Culver............B-3
Danville...........E-3
Decatur...........B-5
East Chicago.......A-2
Elkhart............A-4
Elwood............D-4
Evansville.........H-1
Fort Wayne.........B-5
Frankfort..........D-3
Franklin...........E-4
French Lick........G-3
Gary..............A-2
Goshen............A-4
Greencastle........E-2
Greenfield.........E-4
Greensburg........E-4
Greentown.........C-4
Hammond..........A-1
Hartford City.......C-5
Hebron............A-2
Hobart............A-2
Huntington.........B-4
Indianapolis........E-3
Jasper............G-2
Jeffersonville......G-4
Jonesboro.........C-4
Kendallville........A-5
Kentland..........C-2
Kokomo...........C-3
Lafayette..........C-2
Lagrange..........A-4
La Porte..........A-3
Lebanon..........D-3
Linton............F-2
Logansport........C-3
Loogootee.........G-2
Lowell............B-2
Madison...........G-5
Marion............C-4
Markle............B-5
Martinsville........E-3
Mentone...........B-4
Michigan City......A-2
Mishawaka.........A-3
Mitchell...........G-3
Monticello.........C-3
Montpelier.........C-5
Muncie............D-5
New Albany........G-4
New Castle........D-5
New Harmony......H-1
Noblesville........D-4
North Terre Haute..E-2
North Vernon.......F-4
Oakland City.......G-2
Oolitic............F-3
Osgood............F-5
Palmyra...........G-4
Pendleton.........D-4
Peru..............C-4
Plymouth..........A-3
Portage...........A-2
Portland..........C-5
Prairie City........E-2
Princeton..........G-1
Redkey............C-5
Remington.........C-2
Rensselaer........B-2
Reynolds..........C-2
Richmond.........D-5
Rochester.........B-3
Rockport..........H-2
Rockville..........E-2
Rosston...........D-3
Rushville..........E-4
Saint Croix........H-3
Salem.............G-4
Sanborn...........F-2
Santa Claus........H-2
Scottsburg.........G-4
Sedalia............C-3
Seymour...........F-4
Shelburn...........F-2
Shelbyville........E-4
Shoals............G-3
South Bend.........A-3
South Whitley......B-4
Sullivan...........F-2
Syracuse..........A-4
Tell City...........H-3
Terre Haute........E-2
Thorntown.........D-3
Tipton............D-4
Valparaiso.........A-2
Versailles.........F-5
Vincennes.........G-1
Wabash...........C-4
Wanatah..........A-2
Warren...........C-4
Warsaw...........B-4
Washington.......G-2
Waynetown.......D-2
W. Lafayette......C-2
Wheatland........G-2
Whiting...........A-2
Winamac..........B-3
Winchester........D-5
Worthington.......F-2
Wyandotte........H-3

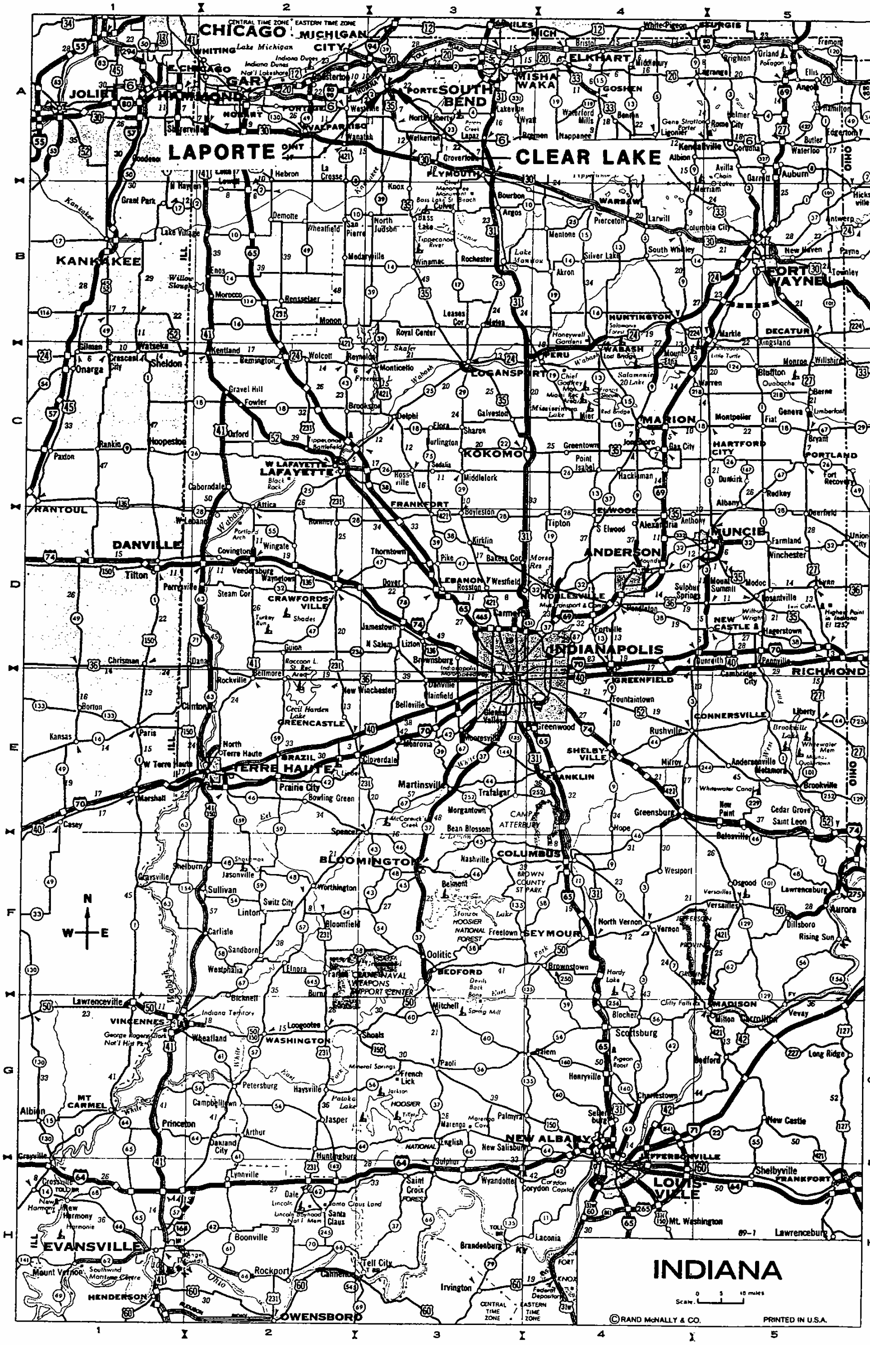
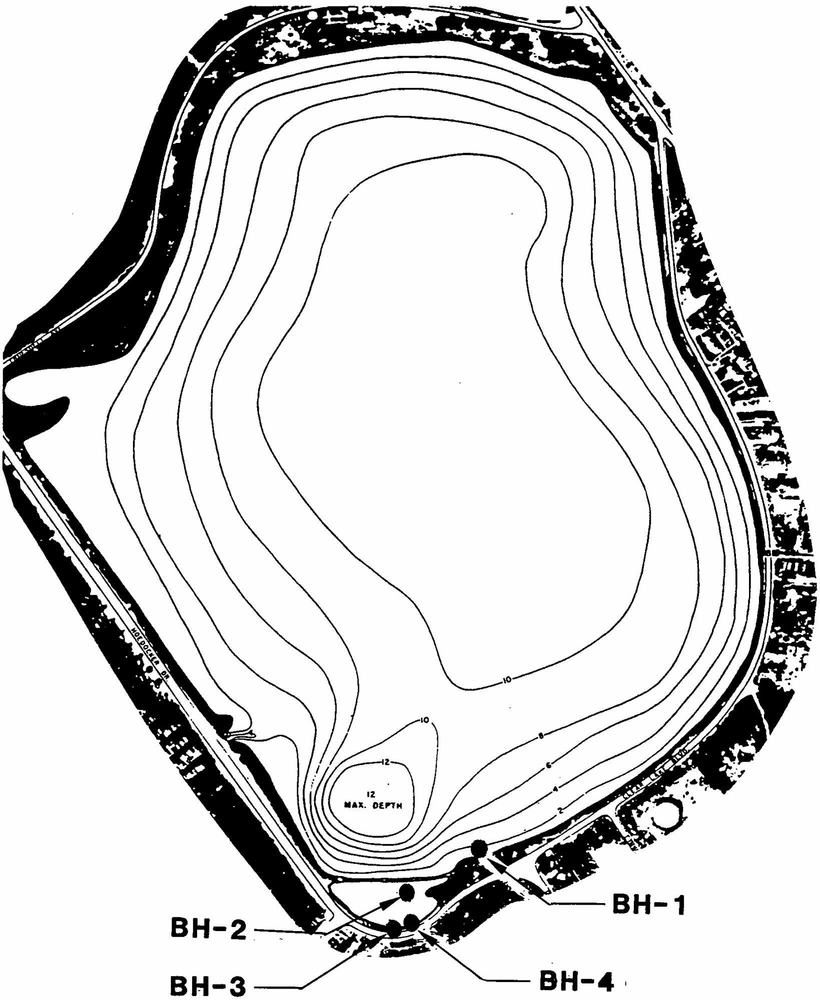


EXHIBIT 2



HARZA ENGINEERING COMPANY

SOIL BORING LOG

Project Number 5129G

Project Name CLEAR LAKE

Client LaPorte Park + Recreation Dist

Contractor HARZA

Drilling Method HAND AUGER

Hole Size 3IN

Driller G.R.O'DONNELL

Logged by C M BROWN

WATER LEVEL	801. ASSUMED	
TIME		
DATE	3/18/93	

Sample Hammer: Weight –

Drop –

Sampler Dimensions 3IN by 10 INCH

Boring No. BH-1

Location Right Abutment SE SHORE

Coordinates: N

E

Ground Elevation ~801 ft

Total Depth 8 1/4 ft

Date Started 3/18/93

Date Completed 3/18/93

Surface Conditions: Snow Cover over the frozen Lake. WATER LEVEL UP ONTO CLEAR LAKE BLVD 5 INCH THICK ICE

Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
0									SNOW 2 INCHES DEEP	EL. 801±
		1							ICE	
		2								
1									Black clayey SANDY ORGANIC SOIL	
		3							BLACK ORGANIC SANDY CLAY SOIL	
2										
		4								
3									DARK GRAY SANDY CLAY + SILT	
		5								
4		6							SAND CONTENT INC.	
5		7	BAG					MV		26% MC
6		8							some gravel, some red clay clasts	
		9							CLAY CONTENT INCREASING	
7		10							GRAY CLEAN, WELL ROUNDED, POORLY GRADED QUARTZ SAND	
		11	BAG					SM		
8										18% MC
									EOB 8 1/4 ft	
9									12[55] PM	

HARZA ENGINEERING COMPANY

SOIL BORING LOG

Project Number 51296

Client LAPORTE PARKS

Contractor HARZA

Drilling Method HAND AUGER

Hole Size 3 IN

Driller C.R O'DONNELL

Logged by C M BROWN

Project Name CLEAR LAKE

WATER LEVEL	SURFACE		
TIME			
DATE			

Sample Hammer: Weight —

Drop —

Sampler Dimensions 3" x 10"

Boring No. BH-2

Location RIGHT CENTER OF SET TIP

Coordinates: N

E

Ground Elevation ~801 ft

Total Depth 12 ft

Date Started 3/18/93

Date Completed 3/18/93

Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
									Surface Conditions: SNOW 2 INCH DEEP	
0		1							ICE	El. 801 ±
1										
2									WATER	
3										
4										El. 796.5 ±
5		2							VERY SOFT BLACK MUCK	
6		3	BAG							
7										
8		4							BLACK CLAY & ORGANIC SOIL	
9		5							GRAY CLAYEY SAND, W/SILT SOME COARSE SAND	El. 792.5 ± 66% MC
		6								

HARZA ENGINEERING COMPANY

SOIL BORING LOG

Project Number 5129G

Client LAPORTE PARKS

Contractor HARZA

Drilling Method HAND AUGER

Hole Size 3 IN

Driller CR O'DONNELL

Logged by C M BROWN

Project Name CLEAR LAKE

WATER LEVEL			
TIME			
DATE			

Sample Hammer: Weight —

Drop —

Sampler Dimensions 3" X 10"

Boring No. BH-2

Location RIGHT CENTER

Coordinates: N

E

Ground Elevation ~801

Total Depth 12 ft

Date Started 3/18/93

Date Completed 3/18/93

Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
									Surface Conditions:	
10		7							GRAY CLAYEY SAND SOME COARSE SAND	
11		8							GRAY COARSE SANDY CLAY	
		9						SM	GRAY CLAYEY SAND	21% Mc
12									EOB 12 ft	

HARZA ENGINEERING COMPANY

SOIL BORING LOG

Project Number 5129G
Client LaPorte Parks
Contractor HARZA
Drilling Method HAND AUGER
Hole Size 3"
Driller CR O'DONNELL
Logged by CM BROWN

Project Name CLEAR LAKE

WATER LEVEL			
TIME			
DATE			

Sample Hammer: Weight —
Drop —
Sampler Dimensions 3" x 10"

Boring No. BH-3
Location Near Inlet Along ...
Coordinates: N
E
Ground Elevation 799
Total Depth 7 FT
Date Started 3/18/93
Date Completed 3/18/93

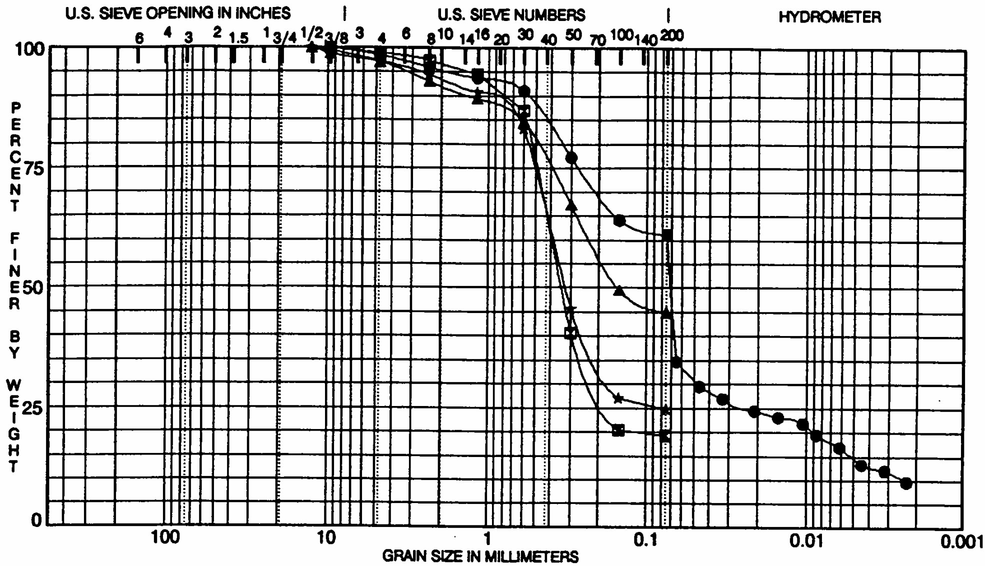
Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
									Surface Conditions: GRASS	
0										El. 799
		1								
1		2							TOPSOIL SANDY ORGANIC SOIL	18"
		3								
2		4							REDBROWN CLAYEY SAND	
3										
		5								
4		6							REDBROWN CLAYEY SAND w/ shale frags	
									CLAYEY SAND	
5										
		7							BLACK CLAY SAND w/ ORGANICS	
6										El. 793 ±
		8							GRAY WELL ROUNDED, POORLY GRADED QUARTZ SAND, SOME Shale fragments	
7									EOB 7ft DEEP	
8										

HARZA

Sheet No. ______

Date 2.4.93

Project Name CLEAR LAKE Project Number 5129G



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	MC%	LL	PL	PI	Cc	Cu
●	BH-1 S-7	4.5	SANDY SILT ML	26	NP	NP	NP		
⊠	BH-1S-11	7.5	SILTY SAND SM	18	NP	NP	NP		
▲	BH-2 S-5	8.5	SILTY SAND SM	66	NP	NP	NP		
★	BH-2 S-9	11.0	SILTY SAND SM	21	NP	NP	NP		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BH-1 S-7	4.5	9.50	0.07	0.048	0.0024	1.6	37.4	46.5	14.5
⊠	BH-1S-11	7.5	9.50	0.40	0.208		1.1	79.7	19.2	
▲	BH-2 S-5	8.5	12.50	0.23			3.0	52.1	44.9	
★	BH-2 S-9	11.0	12.50	0.39	0.167		2.8	72.4	24.8	

			Organic Content,%
BH-2	S-3	6.0'	13.8

Appendix C

SEDIMENT TESTING

NET
NATIONAL ENVIRONMENTAL TESTING, INC.®

Bartlett Division
850 W. Bartlett Rd.
Bartlett, IL 60103
Tel: (708) 289-3100
Fax: (708) 289-5445

ANALYTICAL REPORT

Mr David B Pott
HARZA ENGINEERING CO.
233 So. Wacker Drive
Chicago, IL 60606

06/02/1993

NET Job Number: 93.03484

Enclosed are the Analytical Results for the following samples submitted to NET, Inc. Bartlett Division for analysis:

Project Description: 5129G; Clear Lake Project

Sample Number	Sample Description	Date Taken	Date Received
209283	Sediment	05/01/1993	05/05/1993

Sample analysis in support of the project referenced above has been completed and results are presented on the following pages. Please refer to the enclosed "Key to Abbreviations" for definition of terms. Should you have questions regarding procedures or results, please do not hesitate to call. NET has been pleased to provide these analytical services for you.

Approved By:

Neal E. Cleghorn
Operations Manager

NET Midwest, Bartlett Division

KEY TO ABBREVIATIONS and METHOD REFERENCES

<	:	Less than; When appearing in the results column indicates the analyte was not detected at or above the reported value.
mg/L	:	Concentration in units of milligrams of analyte per liter of sample. Measurement used for aqueous samples. Can also be expressed as parts per million (ppm).
ug/g	:	Concentration in units of micrograms of analyte per gram of sample. Measurement used for non-aqueous samples. Can also be expressed as parts per million (ppm) or mg/Kg.
ug/L	:	Concentration in units of micrograms of analyte per liter of sample. Measurement used for aqueous samples. Can also be expressed as parts per billion (ppb).
ug/Kg	:	Concentration in units of micrograms of analyte per kilogram of sample. Measurement used for non-aqueous samples. Can also be expressed as parts per billion (ppb).
B	:	Sample result flag indicating that the analyte was also found in the method blank analysis. The value after the B indicates the concentration found in the blank analysis.
E	:	Sample result flag indicating that the reported concentration exceeds the linear range of the instrument for that specific analysis and should be considered estimated.
TCLP	:	These initials appearing in front of an analyte name indicate that the Toxicity Characteristic Leaching Procedure (TCLP) was performed for this test.
%	:	Percent; To convert ppm to %, divide the result by 10,000. To convert % to ppm, multiply the result by 10,000.
Dry Weight	:	When indicated, the results are reported on a dry weight basis. The contribution of the moisture content in the sample is subtracted when calculating the concentration of the analyte.
ICP	:	Indicates analysis was performed using Inductively Coupled Plasma Spectroscopy.
AA	:	Indicates analysis was performed using Atomic Absorption Spectroscopy.
GFAA	:	Indicates analysis was performed using Graphite Furnace Atomic Absorption Spectroscopy.
PQL	:	Practical Quantitation Limit; the lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.

Method References

(1) Methods 1000 through 9999: see "Test Methods for Evaluating Solid Waste", USEPA SW-846, 3rd Edition, 1986.

(2) ASTM "American Society for Testing Materials

(3) Methods 100 through 499: see "Methods for Chemical Analysis of Water and Wastes", USEPA, 600/4-79-020, Rev. 1983.

(4) See "Standard Methods for the Examination of Water and Wastewater", 17th Ed, APHA, 1989.

(5) Methods 600 through 625: see "Guidelines Establishing Test Procedures for the Analysis of Pollutants", USEPA Federal Register Vol. 49 No. 209, October 1984.

(6) Methods 500 through 599: see "Methods for the Determination of Organic Compounds in Drinking Water," USEPA 600/4-88/039, Rev. 1988.

HARZA ENGINEERING COMPANY

CHAIN OF COVERAGE FORM

~~230~~ 233 South Wacker Drive • Chicago, Illinois 60606-4288 • Telephone (312) ~~855-7000~~ 831-3000 • Fax (312) ~~236-6040~~ 831-3999

Project name: Clear Lake	Project number: 5129 G	Sampled by: *(Signature)* [signature]

Notes:

Sample number	Sample Station and Description	Number of fractions collected: Water: Chilled	HNO3	H2SO4	Microbiol	Oil & grease	Pesticide, Organics	Sediment	Tissue	Others (note)	Sample type: Comp.	Grab	Filter pad	Matrix (specify)	Sample collection: Date	Time	Discard Date
1	Clear Lake							1			X				1 May '93	12:00 hrs	1 July 93

	Date	Time		Date	Time
Shipping method: Federal Express			Shipped by: *(Signature)* [signature]	4 May 93	
Received for laboratory by: *(Signature)* [signature] NET	5/5/93	0951	Relinquished by: *(Signature)*		
Received by: *(Signature)*			Relinquished by: *(Signature)*		
Received by: *(Signature)*			Relinquished by: *(Signature)*		
Received by: *(Signature)*			Relinquished by: *(Signature)*		
Received by: *(Signature)*			Relinquished by: *(Signature)*		

Appendix D

HYDROLOGY & HYDRAULICS

Location Chicago Office **Date** March 28, 1995

To David B. Pott

From Wade P. Moore

Subject IDNR comments on Clear Lake Report

I have reviewed IDNR's comments on our previous hydrology/hydraulic analysis and have the following comments.

Peak Runoff The IDNR computes, using a variety of methods, a 100-yr peak inflow to the lake of between 400 and 450 cfs. CMB computed a 50-yr peak inflow of about 390 cfs (Appendix D, page 4). It is not clear to me from the computations why CMB used a 50-yr event, however, he was only using that value to compare with the sewer capacity, as discussed below.

Peak Inflow The drainage basin upstream of the lake is almost completely urban with a dense network of storm sewers conveying the runoff flow to the lake. Also, most of the basin is separated form the lake by railroad embankments, effectively eliminating the possibility of overland flow from the upstream areas. Thus, the majority of the flow must enter the lake through the 48" storm sewer passing under the Penn Central Railroad tracks to the south of the lake. After examining the storm sewer drawings and estimating the likely maximum level of upstream ponding, I compute a maximum inflow of about 130 cfs. This is larger than the 100 cfs computed by JRT in the hydraulic comps (Appendix D, page 3) but much less than the peak runoff rate computed by the IDNR. IDNR did not estimate an inflow rate.

The analysis that was done by CMB/JRT was crude but served the intended purpose given the inherent inexactness of the design of sediment basins. Two parameters are needed: the maximum inflow rate and the travel time through the basin. If it is necessary to more accurately compute the maximum inflow rate as well as the volume and duration, I suggest that we consider constructing a computer model of the upstream watershed that includes the attenuating effects of the storm sewers, street ponding, railroad embankments, etc. and also incorporates the direct runoff to the lake from adjacent areas. The model will provide inflow hydrographs for any rainfall event that we care to examine. I have recently done detailed modeling like this for Elmhurst and Hoffman Estates with good success. The cost of this study would be about $8,000. To better estimate the travel time, a two-dimensional flow computer model can be constructed of the settling basin. The model will generate velocity vectors at selected points in the basin from which the particle travel times can be computed. The model will also allow us to vary the weir openings to get the best flow spread. CYW has recently done several models like this.

This information should address all of IDNR's concerns about the hydrologic analysis and provide a more realistic basis for the design of the settling basin.

SUBJECT

COMPUTED DATE
CHECKED DATE
BACKCHECKED DATE

PROJECT NAME
PROJECT NUMBER
Page of Pages

$\phi = 48''$ $A = 12.6\ ft^2$ $R = 1'$
$n = 0.015$

$$Q = \frac{1.49 S^{1/2}}{n} A R^{2/3} = 1251.6\ S^{1/2}$$

pool elevation ~ 798.2

- ground elev other side of NYC tracks ~ 807.5

$$S = \frac{807.5 - 798.2}{850'} = 0.011$$

$Q = 131$ cfs

-

NLS 4-19-95

Clear Lake, LaPorte, IN
ANNUAL RUNOFF VOLUME

Purpose: Estimate annual runoff volume.

References:

Harza, "Clear Lake Enhancement Project, Sediment Trap Improvement, Supporting Design Report," Chi., Oct. 1993, pp. D-4, -5.

Environmental Data Service, "Monthly Normals of Temperature, Precipitation, and Heating and Cooling Degree Days 1941-70," Clim. of US No. 81 (Indiana), Natl. Clim. Center, Asheville, NC, Aug. 1973.

SCS, "Urban Hydrology for Small Watersheds," TR 55, 2nd ed., Wash., DC, June 1986, p. 2-5.

B.R. Urbonas and L.A. Roesner, "Hydrologic Design for Urban Drainage and Flood Control," Handbook of Hydrology, McGraw-Hill, NYC, pp. 28.1-.2.

USGS, "Water Resources Data, Indiana, Water Year 1984," WDR IN-84-1, Indianapolis, 1985, pp. 30, 186, 187, 211.

Data: DA = 88 ac (Harza)
Normal annual precipitation = 47.7 in/yr (EDS)

Method: Annual precipitation x rainfall-runoff coefficient

Procedure:

Land Use	Area, ac (Harza)	% Impervious (SCS)	A x I
Commercial	46	85	3910
Industrial	41	72	2952
Park	1	20	20
	-----	-----	-----
	88		6882
Weighted		78 (insensitive to park % imperviousness)	

Runoff/rainfall volumes ratio ~ 0.55 (Urbonas, NURP graph)

Average runoff volume = 48" x 0.55 =	26	in/yr
/12 =	2.2	ft/yr
x 88 ac =	194	AF/yr
x 0.326 =	63	mil. gal./yr

Comparison to USGS streamgage runoffs, more pervious -

No.	Stream, Gage	Drainage Area, mi2 Total	Drainage Area, mi2 Contrib.	Average RO, in/yr Total A	Average RO, in/yr Contrib. A
4095300	Trail Cr. at Michigan City	54.1	54.1	18.22	18
4096100	Galena R. nr. LaPorte	17.2	14.9	20.13	23
5515400	Kinsbury Cr. nr. LaPorte	7.08	3.01	8.08	19

Thus, Clear Lake value of 26 in/yr reasonable

Result: Average annual runoff approximately 63 million gal.

NLS 4-19-95

Clear Lake, LaPorte, IN
BASEFLOW

Purpose:	Estimate annual baseflow volume (if any)
Data:	Not known if any baseflow Average annual runoff estimated as 63 mil. gal.
Method:	Judgment
Proce-dure:	Guess 10 % of average runoff, = 0.1 x 63 = 6 mil. gal./yr
Result:	6 mil. gal./yr guestimate

Clear Lake, LaPorte, IN
STORMWATER DISCHARGES

Purpose: Estimate range of peak and average stormwater discharges for common rain events.

Data: Pipe capacity about 130 cfs (WPM 3-95)
A = 88 ac (Harza)
Tc ~ 11 min. (Harza)
Weighted rational-formula C = 0.76 (Harza) for overland runoff

References: Harza, "Clear Lake Enhancement Project, Sediment Trap Improvement, Supporting Design Report," Chi., Oct. 1993, pp. D-4, -5.
W.P. Moore, "IDNR Comments on Clear Lake Report," memo, Harza, Chi., Mar. 28, 1995.
F.A. Huff and J.R. Angel, "Rainfall Frequency Atlas of the Midwest," Bul. 71, Midwestern Climate Center, Champaign, 1992, pp. 6, 54.

Method: Estimate flood peaks for common storms, limit to pipe capacity.
Rational formula

Procedure: Q = CIA
C = 0.76 (Harza)
A = 88 ac (Harza)
Q = 0.76 x 88 x I = 67 x I
Tc ~ 11 min (Harza)

Bulletin 71 -

Dur., min.	Depth, % 24-hr	/60-min=	Depth, % 1-hr
60	47		100
15	27		57
10	21		45
11	22	by interp.	47

Partial-duration 24-hr depths

RI, months	% of 2-Yr Depth
12	83
6	67
4	58
3	53
2	46

Partial-duration 2-yr 1-hr point depth = 1.35 in.

Thus, 2-yr 11-min. depth = 1.35" x 47 % = 0.63 in.

RI, months	Depth, % 2-Yr	Depth, in.	I, in/hr	Q=CIA, cfs	Pipe Q, cfs
24	100	0.63	3.5	231	130
12	83	0.53	2.9	192	130
6	67	0.43	2.3	155	130

4	58	0.37	2.0	134	130
3	53	0.34	1.8	123	123
2	46	0.29	1.6	106	106

Result: Peak discharge for common rain events apparently is limited by or approximately equals pipe capacity. Peaks approximately 100-130 cfs.

No storm hydrographs. Thus, estimate average based on shape of SCS curvilinear dimensionless hydrograph:

Ref. SCS, NEH4, p. 16.4 -

Hr	Q/Qp	Avg	dT, hr	Avg x dT
0	0			
	0.03			
	0.1			
	0.19			
	0.31			
	0.47			
	0.66			
	0.82			
	0.93			
	0.99			
	1			
	0.99			
	0.93			
	0.86			
	0.78			
	0.68			
	0.56			
	0.46			
	0.39			
	0.33			
2	0.28	0.56	2	1.12
2	0.28			
	0.207			
	0.147			
	0.107			
	0.077			
	0.055			
	0.04			
	0.029			
	0.021			
	0.015			
4	0.011	0.089909	2	0.179818
4	0.011			
	0.005			
5	0	0.005333	1	0.005333
				--------
0 to 5				1.305152
Weighted average =		0.26		

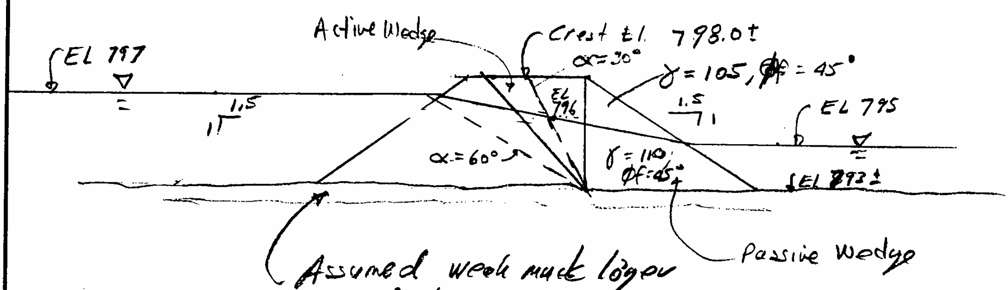
RI, mon	Peak,cfs	x 0.26 =	Ave.,cfs
4	134		35
3	123		32
2	106		28

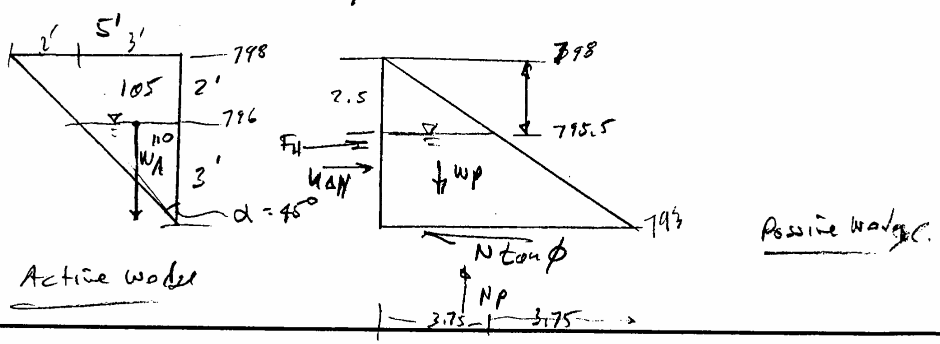
Result: Average flow from commons storms approximately 25-35 cfs.

THE EXISTING RUBBLE FILL DIKE HAS BEEN IN PLACE FOR A NUMBER OF YEARS AND IS INHERENTLY STABLE. THE EXISTING CENTER BREACH IN THE STRUCTURE IS DIRECTLY IN LINE WITH THE 48"φ CMP STORM SEWER PIPE. THIS BREACH WAS PROBABLY PRODUCED BY EROSION FROM HIGH VELOCITY DISCHARGES FROM THE 48"φ CMP. THE BREACH AREA WILL BE FILLED IN AND SUPPORTED WITH MORE MATERIAL.

THE EXISTING RUBBLE FILL DIKE WILL BE CHECKED FOR STABILITY ASSUMING THE WORST CASE SCENARIO WHICH IS PROBABLY SLIDING ON A WEAK STRATA

THE WEDGE METHOD OF ANALYSIS IS APPROPRIATE FOR EMBANKMENTS ON FOUNDATIONS CONTAINING WEAK STRATA





$\vec{W_A} = (110-62.5)(\frac{1}{2})(3')(3') + 105[3' \times 2' + \frac{1}{2}\ 2' \times 2'] =$

$213.75 + 840 = \underline{1054\ lb/ft}$

$\vec{W_P} = 105[2.5 \times 2.5 \times \frac{1}{2}] + (110-62.5)[\frac{1}{2}(2.5 \times 2.5) + 2.5 \times 2.5]$

$328.1 + 445.3 = \underline{773\ lb/ft}$

$\overline{F_V} = \overline{W_A} = 1054\ lb/ft$

$F_H = \dfrac{F_V}{Tan(\phi_c + \alpha)} = \dfrac{1054}{Tan(45+45)} = \dfrac{1054}{\alpha} =$ Very small

assume $\alpha = 44°$ TAN $89° = 57.3$

$F_H = 18.4\ lb/ft$ for $\alpha = 44°$

$U_{\Delta H} = \frac{1}{2}(2.5) \times 62.5 \times (2.5) - \frac{1}{2}(2.5) \times 62.5 \times (2.5)' = 0$

$N_p = 773\ lb/lf = \bar{W_p}$

$N_p \tan\phi$; Worst Case $\phi = 17°$

$773 (\tan 17) = 236\ lb/ft$, (Increasing ϕ to 25° would increase F.S.)

$F.S. = \dfrac{\Sigma \text{ Horiz Resist}}{\Sigma \text{ Horiz Driving}} = \dfrac{236}{18.4} = 12.8$ for $\alpha = 44°$

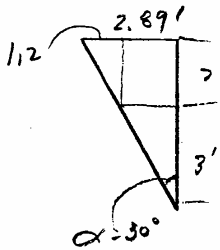
The existing rubble dike is stable with high factor of safety. This assumes that the rubble has a $\phi = 45°$ which is probable.

If ϕ of rubble is 30° How does this affect F.S.

$$\frac{1054}{\tan(45+30°)} = \frac{1054}{\tan 75°} = 282.4 \text{ lb/ft}$$

$$\frac{236}{282.4} = 0.84$$; However, this ϕ is typical of a ϕ for sand, not rubble. If the rubble fill were really sand the entire dike would have washed away by erosion. The fact that the dike is there indicates that the composition of the dike is a stronger rubble material

Check stability for $\alpha = 30°$



$$W_A = (110-62.5)(\tfrac{1}{2} \times 3 \times 1.7) + 105[2 \times 1.2 \times \tfrac{1}{2} + 2 \times 1.69]$$

$$121.1 + 480.9 = 602 \text{ lb/l.f.}$$

Active Wedge

$F_V = W_A$; $F_H = \frac{F_V}{\tan(\phi_e + \alpha)} = \frac{602}{(45+30)} = 161.3 \text{ lb/ft}$

$\therefore$ $F.S. = \frac{236.0}{161.3} = 1.46$ OK

Conclusion: Dike is stable as long as it's constructed of rubble with a $\phi = 45° \pm$.

SUBJECT	Existing Rubble Fill Dike - Stability Analysis	PROJECT NAME	Clear Lake Sediment Trap
COMPUTED	OEK	DATE	4-10-95
CHECKED	WJM	DATE	4/14/95
BACKCHECKED		DATE	
PROJECT NUMBER	5129G	Page 4 of 5 Pages	

The hand calculations were checked using a spreadsheet. The stability hand calculations were correct for $\alpha = 44°$ and $\gamma = 30°$. The results of the spreadsheet show that the minimum factor of safety of 1.31 occurs at $\alpha = 23°$.

The stability analysis was performed assuming worst case conditions (weak muck layer, $\phi_m = 17°$). Therefore, a factor of safety greater than 1.0 is required.

$1.31 > 1.0$ $\therefore$ The dike is stable ✓

City of LaPorte, Indiana
Clear Lake Sediment Trap
Stability Analysis

Wedge Method

Computed By: OEK Date: 10-Apr-95
Checked By: WJM Date: 14-Apr-95

Design Criteria
h1 = 3
h2 = 2
γ = 105
$\gamma\beta$ = 47.5
ϕ = 45

Passive Wedge Resisting Force (lbs) = 236

	Active Driving Force							
α	Wieght 1(lbs)	Weight 2(lbs)	Total Weight(lbs)	Horizontal Force 1(lbs)	Horizontal Force 2(lbs)	Total Hor. Force (lbs)	Resisting Force (lbs)	Factor of Safety
1	3.7	14.7	18.4	3.6	14.2	17.8	236.0	13.29
2	7.5	29.3	36.8	7.0	27.4	34.3	236.0	6.88
3	11.2	44.0	55.2	10.1	39.6	49.7	236.0	4.75
4	14.9	58.7	73.7	13.0	51.1	64.1	236.0	3.68
5	18.7	73.5	92.2	15.7	61.7	77.4	236.0	3.05
6	22.5	88.3	110.8	18.2	71.5	89.7	236.0	2.63
7	26.2	103.1	129.4	20.5	80.6	101.1	236.0	2.33
8	30.0	118.1	148.1	22.6	89.0	111.6	236.0	2.11
9	33.9	133.0	166.9	24.6	96.7	121.3	236.0	1.95
10	37.7	148.1	185.8	26.4	103.7	130.1	236.0	1.81
11	41.5	163.3	204.8	28.0	110.1	138.2	236.0	1.71
12	45.4	178.5	224.0	29.5	116.0	145.5	236.0	1.62
13	49.3	193.9	243.3	30.8	121.2	152.0	236.0	1.55
14	53.3	209.4	262.7	32.0	125.8	157.9	236.0	1.49
15	57.3	225.1	282.4	33.1	129.9	163.0	236.0	1.45
16	61.3	240.9	302.2	34.0	133.5	167.5	236.0	1.41
17	65.3	256.8	322.2	34.7	136.6	171.3	236.0	1.38
18	69.5	272.9	342.4	35.4	139.1	174.5	236.0	1.35
19	73.6	289.2	362.8	35.9	141.1	177.0	236.0	1.33
20	77.8	305.7	383.5	36.3	142.6	178.8	236.0	1.32
21	82.1	322.4	404.5	36.5	143.6	180.1	236.0	1.31
22	86.4	339.4	425.7	36.7	144.1	180.7	236.0	1.31
23	90.7	356.6	447.3	36.7	144.1	180.7	236.0	1.31
24	95.2	374.0	469.2	36.5	143.6	180.1	236.0	1.31
25	99.7	391.7	491.4	36.3	142.6	178.8	236.0	1.32
26	104.3	409.7	513.9	35.9	141.1	177.0	236.0	1.33
27	108.9	428.0	536.9	35.4	139.1	174.5	236.0	1.35
28	113.7	446.6	560.3	34.7	136.6	171.3	236.0	1.38
29	118.5	465.6	584.1	34.0	133.5	167.5	236.0	1.41
30	123.4	485.0	608.4	33.1	129.9	163.0	236.0	1.45
31	128.4	504.7	633.2	32.0	125.8	157.9	236.0	1.49
32	133.6	524.9	658.5	30.8	121.2	152.0	236.0	1.55
33	138.8	545.5	684.3	29.5	116.0	145.5	236.0	1.62
34	144.2	566.6	710.8	28.0	110.1	138.2	236.0	1.71
35	149.7	588.2	737.8	26.4	103.7	130.1	236.0	1.81
36	155.3	610.3	765.6	24.6	96.7	121.3	236.0	1.95
37	161.1	633.0	794.1	22.6	89.0	111.6	236.0	2.11
38	167.0	656.3	823.3	20.5	80.6	101.1	236.0	2.33
39	173.1	680.2	853.3	18.2	71.5	89.7	236.0	2.63
40	179.4	704.8	884.2	15.7	61.7	77.4	236.0	3.05
41	185.8	730.2	916.0	13.0	51.1	64.1	236.0	3.68
42	192.5	756.3	948.8	10.1	39.6	49.7	236.0	4.75
43	199.3	783.3	982.6	7.0	27.4	34.3	236.0	6.88
44	206.4	811.2	1017.6	3.6	14.2	17.8	236.0	13.29

Appendix F

INSPECTION PLAN

CLEAR LAKE SEDIMENT TRAP
LA PORTE, INDIANA

Inspection Plan

Renovation of Existing Barrier Dike

The contractor will be paid a lump sum quantity for renovation of the existing barrier dike, so no material quantity need be verified. The inspector shall verify the quality of the renovation work. The inspector must signify that the renovation work was completed as directed by the plans and specifications before payment for the work will be made.

Removal and Off-Site Disposal of Soft Sediments

Measurement of the quantity of soft sediment removed from the existing sediment trap will be based on survey data. The inspector shall verify that the surveying procedure is accurate for computation of the quantity.

The inspector shall also verify that the final elevations and slopes are excavated as directed by the plans and specifications.

The inspector shall verify that the roadways are cleaned and maintained during the construction period as directed by the specifications.

Transplanting of Wetland Vegetation from Lakeshore onto the Barrier Dikes

Wetland vegetation is not part of the general contract for the Project. The inspector will not be involved in this portion of the Project.

Restoration of Shoreline to Preconstruction Condition

Prior to construction, the inspector shall receive and review videotape or photographic documentation of the Clear Lake sediment trap shoreline area from the contractor. The inspector shall request additional documentation if details of the condition are not shown. After the contractor completes the restoration of the shoreline, the inspector shall verify that the restoration is complete and satisfactory. The inspector will be required to signify that the work is complete before the contractor will receive payment for this item.

Appendix G

O & M/MONITORING PLAN

CLEAR LAKE SEDIMENT TRAP
LA PORTE, INDIANA

Operation & Maintenance/Monitoring Plan

The sediment trap is self-operating under normal conditions. The sediment trap continues to operate removing sediment from storwater inflow until the accumulated sediment reduces the impoundment area or causes inflow to be channelized. Sediment should not be allowed to choke the stormwater inflow culvert.

The existing sediment trap is presently filled with sediment but the time required to fill the sediment trap is unknown and will depend on whether or not the alum dosing system is installed.

The accumulated sediment totals about 5,250 cubic-yards. Accumulated sediment should be removed before the sediment trap operation and stormwater inflow rate is adversely affected. Accumulated sediment should be removed after about 3,150 cubic-yards (60 percent full) have accumulated.

If a sediment loading of 3.5 cubic-yards/acre/year is assumed, then ten years are required to accumulate 3,080 cubic-yards of fill from the 88 acre drainage area. Actual sediment loading may be much less than 3.5 cubic-yard/acre/year and will be affected by any alum dosing system that is eventually installed.

The maintenance cycle for the first lobe only of the sediment trap will be about 10 years. The final determination of the maintenance cycle will be determined based on information gathered during the first five years of the monitoring inspections.

The condition of the barrier dikes, the wetland vegetation, and the sediment basin should be inspected annually during the first five years of operation. If maintenance requirements prove to be minimal, then the inspections could be conducted every two years. Inspection and maintenance report forms are attached.

CLEAR LAKE SEDIMENT TRAP
INSPECTION AND MAINTENANCE
REPORT FORM

TO BE COMPLETED EVERY SUMMER

INSPECTOR: ________________ DATE: ________ CLEAR LAKE ELEV.: ______
PREVIOUS INSPECTION DATE: _________ CONCLUSIONS:________________
____
____
____

BARRIER DIKE

CONDITION OF CREST	CONDITION OF SIDE SLOPES	IS THERE EVIDENCE OF SLOUGHING?

OTHER OBSERVATIONS: ____
____

MAINTENANCE REQUIRED FOR BARRIER DIKE: ________________________
____
____

TO BE PERFORMED BY: ________________ ON OR BEFORE: ______________

COMPLETED BY: ____________________________ DATE: ________________

COMMENTS:

CLEAR LAKE SEDIMENT TRAP INSPECTION AND MAINTENANCE REPORT FORM

SEDIMENT BASIN:

SEDIMENT ACCUMULATION					CONDITION OF BASIN SLOPES	CONDITION OF STORM WATER INFLOW CULVERT
INSPECTION POINTS		CONSISTENCY OF SEDIMENT	DEPTH TO FIRM SEDIMENT	ELEVATION OF FIRM SEDIMENT		
NO.	LOCATION					

OTHER OBSERVATIONS: ____

____

MAINTENANCE REQUIRED FOR SEDIMENT BASIN: ______________________________

____

____

TO BE PERFORMED BY: ________________ ON OR BEFORE: ________________
COMPLETED BY: ____________________________ DATE: __________________

COMMENTS:____

CLEAR LAKE SEDIMENT TRAP INSPECTION AND MAINTENANCE REPORT FORM

WETLAND VEGETATION

CONDITION OF VEGETATION		
SEDIMENT BASIN SHORELINE	BARRIER DIKE CREST	OUTSIDE BARRIER DIKE

OTHER OBSERVATIONS: ____
____

MAINTENANCE REQUIRED FOR WETLAND VEGETATION: ____________________
____
____

TO BE PERFORMED BY: ________________ ON OR BEFORE: ________________

COMPLETED BY: ______________________________ DATE: ________________

COMMENTS: ____

OTHER FEATURES

OBSERVATIONS: ____
____

MAINTENANCE REQUIRED FOR __________: ______________________________
____
____

TO BE PERFORMED BY: ________________ ON OR BEFORE: ________________
COMPLETED BY: ______________________________ DATE: ________________

COMMENTS:

Appendix H

CONSTRUCTION COST ESTIMATE

ESTIMATE

HARZA ENGINEERING COMPANY
CHICAGO, ILLINOIS

Project CLEAR LAKE Date APRIL 7, 1995 Page 1 of 1 Pages

Structure SEDIMENT TRAP Estimated by WJM Checked by OEK

Item No.	ITEM	Quantity	Unit Price	Amount	
1	MOBILIZATION / DEMOBILIZATION	L.S.		10	000
2	SUPPLY AND PLACEMENT OF ROCKFILL (EXISTING BARRIER DIKE)	210 CY	15.00	3	150
3	REMOVAL AND OFF SITE DISPOSAL OF SOFT SEDIMENTS	5250 CY	10.00	52,	500
4	TRANSPORT OF WETLAND VEGETATION FROM LAKESHORE ONTO BARRIER DIKE	50 SY	25.00	1	250
5	RESTORATION OF SHORELINE TO PRECONSTRUCTION CONDITION	L.S.		3	000
6	SURVEYING	L.S		10	000
	SUBTOTAL			79	900
	CONTINGENCY 25%			19	975
	TOTAL CONSTRUCTION COST			99	875
	*CONSTRUCTION ADMINISTRATION			16,	125
	TOTAL			$116,	000

HARZA **CHICAGO**

SUBJECT Q.T.O Computation of Rockfill Quantity			PROJECT NAME	CLEAR LAKE SEDIMENT TRAP
COMPUTED WJM	DATE 4/7/95		PROJECT NUMBER	5129G
CHECKED OEK	DATE 4/12/95			
BACKCHECKED	DATE		Page 1 of 1 Pages	

ADDITIONAL ITEMS TO BID FORM INCLUDE

ROCKFILL TO IMPROVE EXISTING BARRIER DIKE

ALL OTHER ITEMS WILL BE AS ORIGINALLY CALCULATED EXCEPT

SUPPLY AND PLACEMENT OF SAND & GRAVEL FILL FOR NEW BARRIER DIKE. THIS ITEM WILL BE ELIMINATED, THE IMPROVED EXISTING BARRIER DIKE WILL REPLACE THE NEW BARRIER DIKE. 120' length of dike west of breach is assumed to need 1' of fill

- HOLE IN DIKE $\frac{6+13.5}{2} \times 2.5 \times 45' + 120' \times 10' \times 1' = 2297$ CF

- ADDL. FILL IN FRONT OF DIKE $120 \times 9 \times 1 + 9 \times 5 \times 75' \pm = 3375.0$

$$\begin{array}{r} 3375.0 \\ 2297.0 \\ \hline 5672 \text{ CF} \\ /27 \text{ CF/CY} \end{array}$$

$= 210$ CY

USE 210 CY

ALSO THE LENGTH OF TRANSPLANTED WETLAND PLANTS IS REDUCED BY THE LENGTH OF PLANTS ON THE ORIGINAL NEW DIKE.

ORIGINAL NEW + EXISTING $= 250 \times 2 + 100 + 50 = 650$ LF
PLANTS WILL BE 3' WIDE STRIP

THEN 650 LF − 500 LF NOT REQD = 150 LF

$\frac{150' \times 3'}{9 \text{ SF/SY}} = 50$ SY

HARZA
ENGINEERING COMPANY

Construction Management

Intra-Company Correspondence

Location: Chicago Office

Date October 13, 1993

To: D. Pott

From: S. R. Ziegler

Subject: Budgetary Costs
Clear Lake, LaPorte
Sediment Trap

The following prices have been developed for the Clear Lake Sediment Trap Project in LaPorte, Indiana.

For "Supply and Placement of Sand and Gravel Fill for Barrier Dike", a quantity of 14,500 pay cubic yards at a rate of $11.00 per cubic yard yields a total price of $159,500.

This fill price is based on the following assumptions: The material will not sink into the existing ground; the material purchase and hauling costs are based on the purchased fill material being suitable for the project; and, the water level is at 800.7 foot elevation. Contractor's overhead and profit are included.

For "Removal and Off-Site Disposal of Soft Sediments", a quantity of 5,250 cubic yards at a rate of $10.00 per cubic yard yields a total price of $52,500.

This sediment removal price is based on the following assumptions:

> There will be no royalty cost (Dumping Fee) nor any payment received for depositing wet spoil at the nearby (1.5 miles) landfill for cover; No costs are allowed for spreader dozer or flagman at landfill; the excavated material is suitable for landfill cover in a wet condition (No monies are allowed for drying/rehandling); and the dike will support a large crane with clamsheel bucket (~130 tons).

These figures are for budgetary purposes only.

A contingency of 25% should be applied to the estimate as a whole.

Steve Ziegler

Steven R. Ziegler

LC:SRZ/bas